United Nations

Harnessing Climate and SDG Synergy
Quantifying the benefits

THIRD GLOBAL REPORT ON CLIMATE AND SDGS SYNERGIES, 2025

United Nations | Department of Economic and Social Affairs

United Nations Framework Convention on Climate Change

Published by the United Nations

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Acknowledgments

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Co-convened by the United Nations Department of Economic and Social Affairs (UNDESA) and the United Nations Framework Convention on Climate Change Secretariat (UNFCCC), this report builds on their ongoing collaboration and shared efforts to advance climate and sustainable development goals. The findings are the result of the independent work of the Expert Group on Climate and SDG Synergy, and also draw from the three Thematic Reports of the *Synergy Solutions 2025* series.

The development of this year's report greatly benefited from the leadership of the Expert Group co-leads, Luis Gomez **Echeverri** (Colombia), International Institute for Applied Systems Analysis (IIASA), and Heide **Hackmann** (South Africa), CREST, Stellenbosch University. Their dedication and guidance were instrumental in shaping its content.

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This year's report also undertook the significant task of quantifying the benefits of synergies at the global level, with the findings presented in the first section. We would like to give special thanks to the International Institute for Applied Systems Analysis, and more specifically to Dr. Elena **Rovenskaya**, Director of the Advanced Systems Analysis Program, for guiding the modelling work that made these results possible. We also wish to recognise Nikita **Strelkovskii**, who carried out the modelling under her supervision.

As the core member supporting the drafting, editing, and review process, Geoff **Clarke** (Science Writer) played a central role in the report's formulation and development, helping to synthesize complex ideas into a clear and accessible narrative. We also thank Souran **Chatterjee** and Nazifa **Rafa** for their support during the initial stages of the work on quantification, and Tanvi **Mishra** for her contribution to issues related to cities.

Contributing Experts and Reviewers

We gratefully recognize the authors of the thematic reports in the *Synergy Solutions 2025 series*, which has helped enrich the evidence-base on synergistic action. On *"Linking Climate and Health Action in Cities"* we thank: Felix **Creutzig** (Bennett Chair, University of Sussex; Potsdam Institute for Climate Impact Research), Blanca **Anton** (London School of Hygiene & Tropical Medicine), Rebecca **Newbould** (London School of Hygiene & Tropical Medicine), Chenxi **Lu** (Potsdam Institute for Climate Impact Research and Technical University of Berlin), Bernadia Irawati **Tjandradewi** (United Cities and Local Governments Asia-Pacific), Andy **Haines** (London School of Hygiene & Tropical Medicine), Maria **Pushkareva**. On *"Closing the Climate and Disaster Insurance Protection Gap"* we thank: Yannick **Glemarec** (Centre International de Recherche sur l'Environnement et le Développement), Miguel **Solana** (United Nations Development Programme), Fabienne **Babinsky** (United Nations World Food Programme). On *"How Nature Conservation Can Advance SDG and Climate Action"* we thank: Mercedes **Bustamante** (University of Brasília) and Jéssica **Schüler** (University of Brasília).

We are also grateful to the external experts who contributed to the 2025 Global Report and participated in the virtual consultations for the *Synergy Solutions 2025 series:* Xin **Zhou**, Junichi **Fujino**, Mustafa **Moinuddin**, Eric **Zusman**, Nobue **Amanuma** (Institute for Global Environmental Strategies), Pedro **Conceição**, Yanchun **Zhang**, Heriberto **Tapia**, Nabamallika **Dehingia** (HDRO, United Nations Development Programme), Regis **Chapman** (United Nations World Food Programme), Winston **Chow** (Singapore Management University), Kipkorir **Koskei** (Insurance Development Forum), Lindelwe Lesley **Ndlovu** (African Risk Capacity), Mark J. **Nieuwenhuijsen** (ISGlobal), Nathalie **Pettorelli** (Institute of Zoology, London), Jean Paul **Metzger** (University of São Paulo), Peter **Elias** (Centre for Housing and Sustainable Development, University of Lagos), Raj Vikram **Singh** (Coalition for Disaster Resilient Infrastructure), Marco **Springmann** (University of Oxford, School of Environmental Health).

Special Thanks

Special thanks go to the Governments of Denmark, the Netherlands, and Norway, for their generous support.

This year's report was prepared and coordinated thanks to the committed efforts of the team from the convening organizations serving as the Secretariat of Climate and SDG Synergy. Special thanks go to Assistant-Secretary-General Navid **Hanif** (UNDESA) for his continuous leadership and dedication to synergies, including the work of the Expert Group. Under the overall guidance of Juwang **Zhu** and Minoru **Takada** (UNDESA) and Daniele **Violetti** (UNFCCC), Bahareh **Seyedi** (UNDESA) served as the task lead, overseeing day-to-day coordination and strategic support. Particular thanks also to Astra **Bonini**, Chief of the Integrated Policy Analysis Branch (UNDESA) for her valuable insights and feedback. Nadine **Salame**, Aashna **Swarup**, Nina **Engelbrecht**, Nadia **Lie**, Antonia **Keske**, Carolyn **Hayek**, Pragati **Pascale** and Veronika **Ruskova** (UNDESA), and Aiping **Chen** (UNFCCC), among others, played key roles in ensuring smooth operational processes, maintaining the quality of the report, and supporting productive interactions, meetings, and events.

Finally, we thank Camilo J. **Salomon**, the layout artist, whose careful attention to detail and creative direction have given the report its polished and professional presentation.

5 HARNESSING CLIMATE AND SDG SYNERGY
QUANTIFYING THE BENEFITS

Preface

The world is facing an unprecedented convergence of challenges: intensifying natural disasters and impacts of climate change, slowing global growth, rising debt burdens and escalating energy costs are causing economic losses, human suffering and rapid degradation of nature. We are far off track from reaching both our climate and sustainable development goals.

At the same time, we know that much more sustainable, resilient and inclusive development that can drive greener growth, innovation, poverty reduction and cost savings is possible.

This Third Global Report on Climate and SDG Synergies, prepared by the independent Expert Group co-convened by UNDESA and UNFCCC, points the way, quantifying the immense potential of integrated action, as over eighty per cent of SDG targets are directly linked to climate.

The climate and development crises are not separate – they are deeply interconnected, and so must be their solutions. The report finds that a synergistic approach could unlock efficiencies at scale and reduce government spending needed on these crises by some 40 per cent, at a time when the finance gap for SDG action exceeds USD 4 trillion annually and for climate action over USD 6 trillion per year.

This expert report comes at a crucial time: 2025 presents a critical window to maximize the potential of synergistic action, as countries prepare new national climate commitments under the Paris Agreement. These can and should aim to align climate action with sustainable development and the SDGs, by focusing on increasing equitable access to clean energy, more jobs for more people, better health, sustainable food sources, and empowering women and vulnerable groups. The report suggests that tailoring synergistic strategies to country-specific development and climate objectives ensures investments are targeted where they are needed most. In this way, we don't just fight climate change – we can deliver multiple social, economic and environmental benefits.

Massive investments are needed for this effort, and noting that private sector investment is vital, the report makes the argument that by aligning incentives, demonstrating economic value and reducing risk, governments can leverage private funding to magnify the impact of integrated action.

This report expands the growing body of evidence on the clear benefits of synergistic policies and action, building on the expert group's global reports from the past two years, as well as a number of detailed thematic reports examining specific synergies that can yield major impact. Political momentum has been building, with increasing recognition of the need to break down the silos that are holding us back dramatically.

We have the solutions and roadmap, as this report shows. We commit our organizations to do everything within our power to support governments and other actors in turning ambition into alignment – and alignment into action that delivers real results on both climate and sustainable development goals. This is a call for cooperation across ministries and sectors – for a whole-of-society approach. Let us seize this moment of opportunity for transformative change, for people and planet.

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List of Acronyms

AUD	Australian Dollar
BRT	Bus Rapid Transit
CBD	Convention on Biological Diversity
CO_2	Carbon Dioxide
COFOG	Classification of the Functions of Government
DALY	Disability-Adjusted Life Year
EDGAR	Emissions Database for Global Atmospheric Research
EPA	United States Environmental Protection Agency
ES	Ecosystem Services
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FISP	Farmer Input Support Programme
GBF	Global Biodiversity Framework
GDP	Gross Domestic Product
GHG	Greenhouse Gas
Gt	Gigatonne
HDI	Human Development Index
HQ	Headquarters
IAE	International Association of Energy
ILK	Indigenous and Local Knowledge
IMF	International Monetary Fund
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
LEZ	Low Emission Zone
LSE	London School of Economics
MWh	Megawatt Hour
NAP	National Adaptation Plans
NbS	Nature-based Solutions

NCD	Noncommunicable Disease
NDC	Nationally Determined Contribution
NO_2	Nitrogen Dioxide
NZ	New Zealand
NZD	New Zealand Dollar
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
Pg	Petagram
$PM_{2.5}$	Fine Particulate Matter ≤2.5 microns
R&D	Research and Development
SDG	Sustainable Development Goal
tCO_2	Metric tonne of carbon dioxide
UNCCD	United Nations Convention to Combat Desertification
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UN-Habitat	United Nations Human Settlements Programme
UNSD	United Nations Statistics Division
USD	United States Dollar
WHO	World Health Organization
WTTC	World Travel & Tourism Council
YLL	Years of Life Lost

Key Messages

Synergistic action can unlock efficiencies at scale. Acting jointly on climate and sustainable development can deliver almost 40% greater efficiency, freeing resources and maximizing co-benefits across people, planet, and prosperity. With the annual financing gaps for the SDGs and climate action measured in trillions of dollars, synergistic action is not optional but the most efficient and impactful path forward. The *Third Global Report on Climate and SDGs Synergies,* developed by the independent Expert Group on Climate and SDGs Synergies co-convened by UNDESA and the UNFCCC Secretariat, seeks to quantify these benefits and inform policy discourse at all levels.

1. **Climate change and sustainable development are inextricably linked and so are the solutions.** Over 80% of the SDG targets are directly linked to issues of climate change. Synergistic policies can maximise co-benefits and reduce trade-offs across poverty reduction, health, education, gender equality, climate resilience, and ecosystem protection, while siloed approaches risk duplication, inefficiencies, and missed opportunities.

2. **Synergies unlock efficiencies at scale.** Estimates focused on governmental expenditures suggest that acting on climate and human development together can deliver up to 37% greater efficiency in government spending compared to pursuing them in isolation. This allows limited resources to go further – an essential gain given that the current global SDG financing gap exceeds USD 4 trillion annually and climate finance needs approach USD 6.3 trillion per year.

3. **Modelling highlights the scale of opportunity.** Statistical modelling suggests that achieving accelerated progress in human development resulting in the Human Development Index (HDI) reaching 0.835 by 2030 would be associated with additional USD 1.8 to 5.1 trillion in overall global government spending annually, between 2025 and 2030. Meeting the GHG emission reduction objective of fulfilling all NDCs alone could require additional USD 1.1 to 3.1 trillion globally. By contrast, synergistic allocation could reduce total government spending by up to 37%, according to the findings. Although preliminary and limited in scope, this analysis offers a compelling case for synergistic solutions, offering a touchstone for understanding the potential scale of gains and helping decision-makers in prioritising investments that deliver multiple benefits. The intention is to broaden the analysis in future reports, adding other benefits, including the social sector issues such as lives saved.

4. **Synergistic action aligns with strategic national priorities.** Tailoring synergistic strategies to country-specific development and climate objectives ensures investments are targeted where they are needed most, minimises duplication, and ensures resources are used effectively to deliver multiple social, economic, and environmental benefits. This can help avoid trade-offs between competing agendas and support governments in meeting both their local and national priorities as well as their global commitments efficiently and equitably.

5. **Investing in adaptation is essential for maximising the effect of synergistic approaches.** Adaptation is inherently linked to development and generates multiple co-benefits, including improving livelihoods, health, infrastructure, and community resilience, while complementing mitigation efforts. Further work will be required to account for these opportunities that could significantly increase the overall impact of synergistic climate and development action.

6. **Leveraging private finance can amplify impact.** Private sector investment is vital for scaling synergistic climate and development strategies. By aligning incentives, demonstrating economic value, and reducing risk, governments can leverage private funding to magnify the impact of synergistic approaches, complementing public resources and unlocking additional climate and development co-benefits. Further efforts are required to better align private finance with the SDGs and climate action.

7. **Thematic insights offer practical entry points for implementation.** Deep dives on biodiversity, cities, and finance show how integrated approaches deliver co-benefits for health, ecosystems, and vulnerable communities:

- *Nature protection:* Conserving biodiversity and restoring ecosystems stabilizes climate and supports health, with long-term benefits outweighing costs. Nature-based Solutions could deliver up to 37% of cost-effective CO_2 mitigation by 2030. Yet financing falls far short: a USD 700 billion biodiversity gap and USD 359 billion adaptation gap persist, while harmful subsidies dominate.
- *Cities:* Cities drive most global emissions and face severe health risks from pollution, heat, and inactivity, but also concentrate resources for action. Four pathways deliver major co-benefits: cleaner air from fossil fuel phase-out, plant-based diets, increased physical activity through active travel, and resilient urban design. Quantifying these synergies helps align climate strategies with development priorities and unlock resources.
- *Climate and disaster insurance:* The protection gap is vast: 62% of global disaster losses go uninsured; in Africa, only 0.5% are covered. A 1% rise in insurance coverage brings countries 5.8% closer to the SDGs. Closing the gap could extend coverage to 3 billion people with USD 15–25 billion. Integrating insurance into development agendas boosts resilience.

8. **Evidence guides effective action.** Quantifying the benefits of synergistic action helps policymakers guide efficient investments and design coordinated whole of government approaches. Demonstrating their measurable impact strengthens the case for ambitious, synergistic policies and helps identify trade-offs to inform more equitable and inclusive policy choices.

Synergies will be central to informing a post-2030 development framework. The case for synergies is strong: synergistic action could unlock the momentum urgently needed to accelerate progress towards the 2030 Agenda and Paris Agreement goals. A deeper understanding of the benefits of synergies will remain relevant now and beyond, informing discussions on a post-2030 development framework that ensures transition pathways are people-centred, just and inclusive.

Introduction

In a recent briefing to the General Assembly, the UN Secretary-General stated, *"Climate action is the 21st century's greatest opportunity to drive forward all the Sustainable Development Goals"*. This was his urgent call for the need to act jointly on both the climate and the development agendas and to remind everyone that the 2030 Agenda for Sustainable Development and the Paris Agreement are intrinsically linked — *"one cannot be achieved without the other"*.

At the same time, by any set of measures, it is evident that progress towards achieving the goals of either the Paris Agreement or Agenda 2030 is significantly off track. The eight years since the Paris Agreement entered into force have been the warmest on record and while the Agreement has had a positive impact in reducing future potential temperature increases, carbon emissions and temperatures are increasing with 2023–2024 the warmest year on record at 1.48°C above pre-industrial levels. The recent Sustainable Development Report 2025 states *"Only 35 per cent of SDG targets with available trend data are on track or show moderate progress. Nearly half are moving too slowly or making only marginal progress, while 18 per cent have regressed"* (UNDESA, 2025). Clearly, decades of incremental action have failed to make any significant progress or have an impact at the pace and scale necessary to tackle climate change or sustainable development. The lack of transformational progress has many reasons but fundamentally is caused by the deep fragmentation and inertia in global systems – politics, governance and public administration, economy and finance, and education and innovation – that were mostly designed and implemented under a very different set of global conditions from what the world now faces. In short, many of these systems are no longer fit for purpose in the 21st century.

Background

This report builds on the recent work convened and carried out under the umbrella of the UN Department of Economic and Social Affairs (UNDESA) and the United Nations Framework Convention on Climate Change (UNFCCC)[1]. This work grew out of global conferences designed to promote synergistic action between the Sustainable Development Goals (SDGs) and the climate agendas, the Copenhagen Conference in 2019, the Webinars of 2020 and 2021 hosted jointly by the UNDESA and UNFCCC, the Third Global Conference on Synergies of 2022 hosted by the Government of Japan, and subsequent global conferences at UNHQ in New York (2023), Rio de Janeiro, Brazil (2024) and Copenhagen, Denmark (2025). These global conferences provided the platform, rationale and urgency for the work which has been undertaken since 2023 with the involvement of a distinguished Expert Group convened by UNDESA and UNFCCC, representing several disciplines and regions of the world.

The first global report of the Expert Group on Climate and SDG Synergy, *Synergy Solutions for a World in Crisis: Tackling Climate and SDG Action Together* (2023), highlighted several reasons for pursuing synergies, including addressing investment gaps, enhancing collective resilience against global crises, promoting institutional capacity-building, ensuring policy coherence. It also offered recommendations to accelerate a joint pursuit of climate action and sustainable development, which included: strengthening the science-policy-society interface and explaining why this was critically important, promoting institutional capacity building, ensuring policy coherence, developing a framework for action, ensuring a just transition, addressing investment gaps, and utilising relevant political processes to promote synergies.

The next edition of the Expert Group report, *Synergy Solutions for Climate and SDG Action: Bridging the Ambition Gap for the Future We Want* (2024), built on the growing body of evidence on the benefits of synergistic policies and action, also drawing insights from thematic reports of the 2024 *Seeking Synergy Solutions* series. While there is growing recognition of the importance of synergistic approaches to climate and development policy, as the 2024 report demonstrates, fragmentation across governance, finance, and policy continues to hinder progress, necessitating reforms for effective and inclusive action. Achieving these goals requires sustained commitment and collaboration.

The generally poor adoption of a synergistic approach to addressing the 2030 Agenda and Paris Agreement can be attributed to a weak science-policy-society interface and the fact that there remains a sizeable disconnect between scientific evidence and applied policy action. Addressing this can ensure the best evidence-based policies are developed and implemented.

Purpose of the Report

Despite the benefits offered by synergistic efforts, as highlighted in previous reports, the low uptake of synergistic actions by policymakers remains a perplexing challenge – demonstrated by the fact that very few, if any, of the major climate and SDG policy instruments and data such as Nationally Determined Contributions (NDCs), Long-Term Low-Emissions Development Strategies (LT-LEDS), National Adaptation Plans (NAPs), and Voluntary National Reviews (VNRs) expressly address the other. It is obvious that a variety of obstacles exist that impede the broad creation and use of policies that concurrently address the development and climate agendas.

Arguably one of the greatest obstacles identified to date has been the general lack of robust quantitative data on the economic and sustainable development benefits of adopting a synergistic approach. Meaningful action on both the climate and sustainable development agendas requires significant investment and expenditure – both public and private. As with all investments, those making the outlays are primarily interested in the potential returns on their investment.

Not all such returns are necessarily purely financial in nature. This is particularly true in terms of climate action and sustainable development where non-market returns and benefits can be equally, or even more, important than pure financial returns or savings. For example, the social and environmental benefits of poverty and pollution reductions, improvements in health and education, and protection of natural resources and biodiversity are quantifiable, although not necessarily in direct financial terms.

Despite this important observation, the question remains as to how much it will cost or how much can be saved by adopting a synergistic approach to climate action and development as opposed to investing in each separately. Addressing this question is the focus of this report. However, simply having 'one number' or quantifiable figure is only part of the answer. Equally, or arguably more important, is HOW to reap the financial benefits of a synergistic approach, *viz*. what are the policy frameworks, financial architecture and instruments, knowledge and data, and institutional and social structures required to effectively implements a synergistic approach. Although, many of these issues have been addressed in previous reports, there remains a general lack of practical options for effectively harnessing climate and SDG synergies.

This report is presented in two sections. Section 1 shows the scale of opportunity that synergistic action can unlock globally through a modelling exercise that estimates the plausible effects of synergies between climate and development action at the global level in terms of public spending savings. Section 2 then draws on the *Synergy Solutions 2025* series of thematic reports to offer actionable insights that enrich the global picture, offering practical entry points for implementation.

1

The Scale of Opportunity: Estimating Global Synergies Between Climate and Development Action

1.1 Study Scope

Government expenditures represent a critical and actionable lever for driving climate and development progress. Unlike private investments or market-based mechanisms, public spending is directly controlled by policymakers, ensuring accountability and alignment with national priorities. Additionally, government budgets are transparent and subject to public scrutiny, enabling citizens to track progress and demand results. As one important approach, estimating the public spending needed to achieve key societal goals provides a valuable benchmark. Beyond its intrinsic value, it can also help assess the relative efficiency of alternative approaches, such as private investment, and guide coordinated action where market forces alone fall short.

This study employs statistical modelling[2] to connect government expenditures and progress in sustainable development and climate. An illustrative model has been developed that tracks sustainable development through the Human Development Index (HDI) and climate action via GHG emission reductions. Its core output is the estimation of government expenditures associated with the achievement of defined targets – either pursuing these targets separately or through a coordinated, synergistic approach.

While the HDI captures only core aspects of sustainable development – multidimensional socioeconomic progress in health, education, and living standards – it was chosen in this model as it is regularly updated, well-recognised, and a widely accepted and used measure of development. Similarly, reductions in GHG emissions is a commonly used proxy for climate action. Additionally, the model controls for the effects of economic growth via GDP a control variable, reflecting the fact that economic growth is strongly linked to the progress in both human development and GHG emission growth. A dummy variable distinguishing between advanced and developing and emerging economies is used as another control variable to recognize countries' heterogeneity. Lastly, the equation for GHG emission reduction employs the share of renewable energy in the total final energy consumption as an additional control variable to reflect technological diffusion. While this selection of variables has inevitable simplifications (as any alternative would), these indicators offer three key advantages: robustness, relevance and broad acceptance in the policy communities, and crucially, comprehensive data availability across a wide range of countries.

Although private finance is crucial for climate action and development, it is not included in the model as a separate driver due to challenges in data availability. However, the model implicitly accounts for the catalytic function of public spending. For instance, government investment in R&D de-risks technologies and enhances the attractiveness of renewables, thereby scaling up private sector participation. The estimated results presented in this report reflect such catalytic effects. In this phase, the model also does not yet include either expenditures or indirect effects from climate adaptation, reflecting present data constraints. Future work will address these aspects as data availability improves. A more comprehensive discussion of the model assumptions, their justifications and limitations can be found in Section 1.4 below.

Finally, the study was not intended to forecast, but rather to illustrate the scale of opportunity that synergistic climate and development action could offer, based on a crude estimate of its potential effects under several critical assumptions. The goal is to contribute to the conversation about climate and development synergies and help make the case for ongoing discussions among policymakers on how to accelerate the implementation of the Paris Agreement and Agenda 2030.

1.2 Methodology

Target scenarios

Between 2010 and 2019, the world's HDI increased from 0.707 to 0.745, representing a 0.038-point rise (UNDP, 2025). This study assumes a scenario in which the world HDI grows from 2020 at twice the rate of the HDI growth trend from 2010 to 2019, achieving 0.835 by 2030, up from 0.756 in 2023. The assumption is that this target should be achieved following a linearly increasing trajectory between 2024 and 2030 (Figure 1A).

To specify the success of climate action, this study assumes a 10% reduction of GHG emissions from the 2019 level by 2030, which corresponds to the full fulfilment of NDCs (both conditional and unconditional) globally (UNEP, 2024). Similarly to the development scenario, a linearly decreasing trajectory of the GHG emissions is assumed from 2024 to 2030 (Figure 1B).

FIGURE 1A. Human Development Index (HDI), world

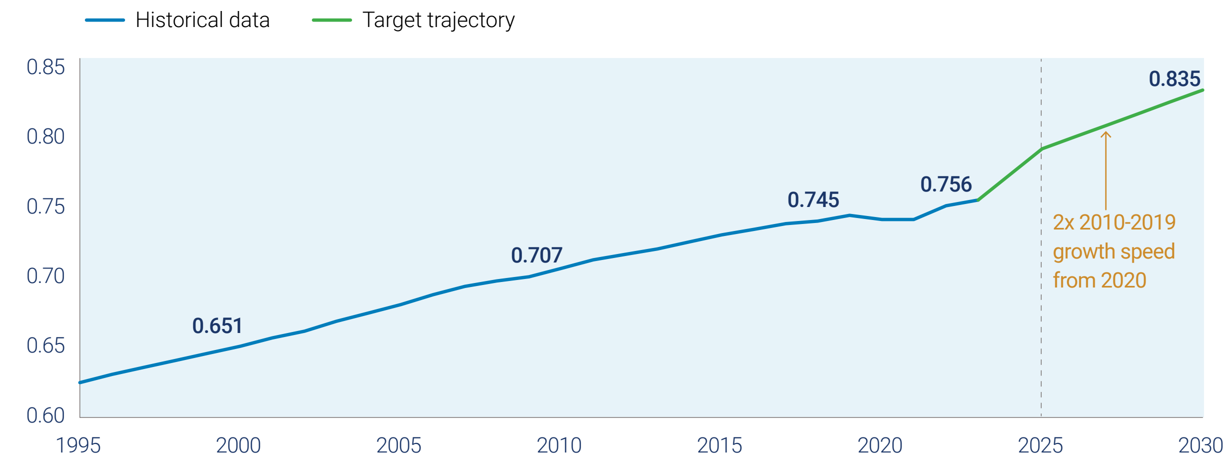
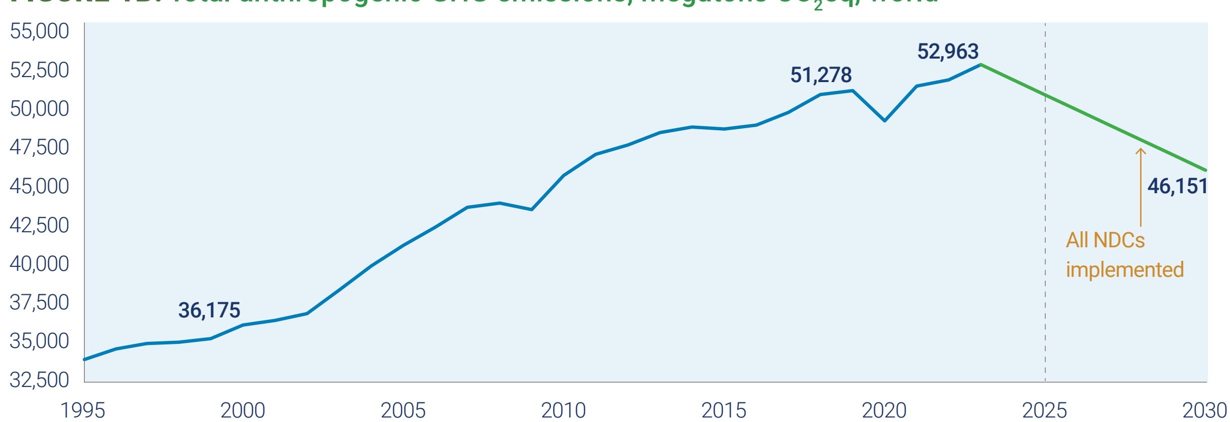


FIGURE 1B. Total anthropogenic GHG emissions, megatons CO_2eq, world



The development action scenario and the climate scenario considered in the present study (2024-2030), alongside the historical world data on HDI and GHG emissions over 1995-2023. GHG emissions data are from the Emissions Database for Global Atmospheric Research (EDGAR) (Crippa *et al.*, 2024) and HDI data are from UNDP (https://hdr.undp.org/data-center/human-development-index#/indicies/HDI).

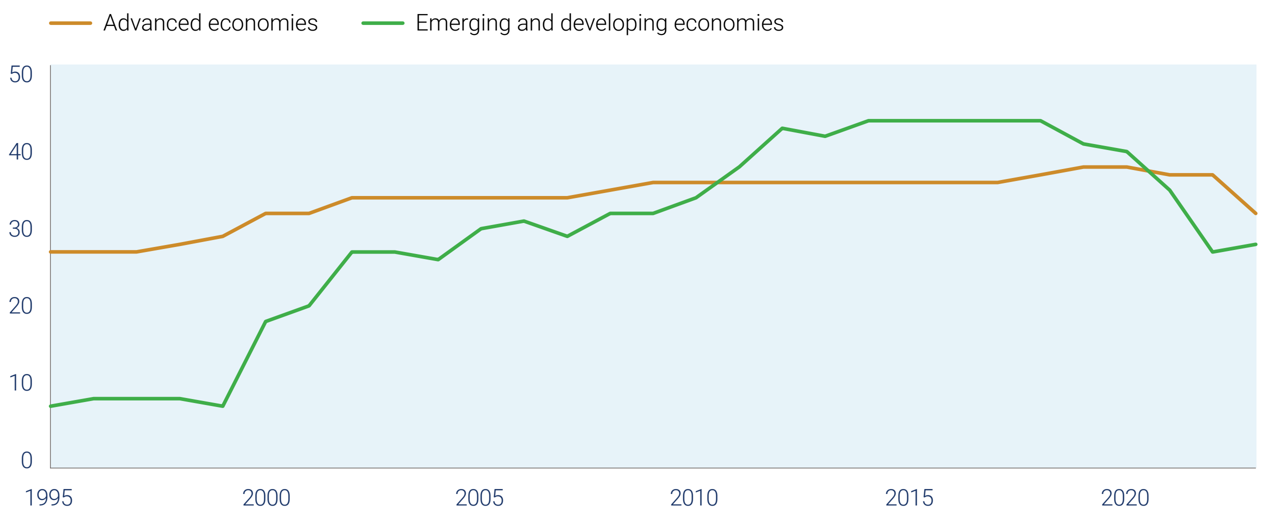
Model

This study relies on the hypothesis that progress in climate and development can be associated with higher government spending. This hypothesis is tested using a dataset spanning the period of 1995 to 2023 for 178 countries, comprising 39 advanced economies and 139 emerging and developing economies. This dataset was generated through the integration of multiple open-source datasets. Data gaps were addressed using imputation techniques.

Government expenditures are broken down into ten sectors according to the Classification of the Functions of Government (COFOG) – a statistical standard developed by the United Nations Statistics Division (UNSD) to categorize government spending based on its purpose. To have as much data as possible, this study combined data on governmental expenditures from the IMF[3] and UNCTAD[4], the two most extensive sources of such data available globally. However, significant data gaps still exist, which were filled through imputation (Figure 2).

Full details and mathematical formulas for the imputation approach and its results, the model, and scenario calculations are provided in Appendix 1.

FIGURE 2. Number of countries with full data



Country coverage by the government expenditure datasets, 1995–2023. The chart displays the number of countries with complete data available for each year, broken down into advanced economies and emerging and developing economies. While data availability has improved substantially over the period, particularly for the latter group, the drop-off after 2020 reflects typical lags in data reporting.

1.3. Estimation of synergies

Applying the fitted models to the world, the 'optimal' government expenditures associated with the achievement of the target levels of HDI and GHG emissions are computed, in three different scenarios.

Scenario 1 – *Development action only.* In this scenario, a distribution of government expenditures across ten COFOG sectors is determined which together make up the lowest total government spending while ensuring that the target HDI level is achieved.

Scenario 2 – *Climate action only.* In this scenario, similarly to the previous one, a distribution of government expenditures across ten COFOG sectors is determined which together make up the lowest total government spending while ensuring that the target GHG emissions level is achieved.

Scenario 3 – *Development and climate synergies*. In this scenario, a distribution of government expenditures across ten COFOG sectors is determined which together make up the lowest total government spending while ensuring that both the target GHG emissions level and the target HDI level are achieved.

Under all scenarios, government expenditure in every sector is constrained to remain at or above its 2024 baseline to avoid potential shortfalls on other objectives of the governments, not directly related to climate or sustainable development.

Intra-sectoral non-fungibility: This metric assumes that government expenditures (beyond the projected baseline levels) associated with the achievement of each target, climate and development, in scenario 1 *Development action only* and scenario 2 *Climate action only* are not fungible. Therefore, pursuing these two targets in isolation leads to these expenditures adding one to another. Synergies are then calculated as the sum of the above-baseline government expenditures in scenarios 1 and 2, less the above-baseline expenditures in scenario 3, in which both targets are achieved simultaneously.

Intra-sectoral fungibility: Fungible above-baseline spendings is a form of synergy. Full fungibility between climate and development objectives within each COFOG sector would mean that pursuing these two targets in isolation can be cheaper, as the higher sectoral budget assimilates a smaller one. In this case, synergies are calculated as the sum of the above-baseline government expenditures associated with the achievement of climate and development targets after this assimilation, less the above-baseline expenditures in scenario 3.

The scenarios were run for the years 2025 through 2030. Figure 3 presents the results for all three scenarios.

In 2025, above-baseline government expenditures of USD 1.5 and 0.4 trillion are associated with a world that is on track to achieve the target HDI of 0.835 and meet the GHG emission target in 2030, respectively. However, when allocations to achieve these targets are optimized separately, they are directed to different sectors of government expenditures, underscoring the persistence of trade-offs between climate and development. Simultaneous achievement of both targets allows the harnessing of synergies through government allocation to sectors which facilitate both increasing HDI and decreasing GHG emissions. Prioritization of government expenditures into such sectors reduces the total amount associated with the achievement of both targets by about 22% in the case of synergy under the intra-sectoral non-fungibility assumption and by 9% in the case of synergy under the intra-sectoral fungibility assumption, in 2025. The government expenditures associated with the synergistic pursuit of both climate and development are only 4% higher than the baseline government expenditures.

As we move from 2025 towards 2030, the level of public finance required to achieve the increasingly ambitious HDI targets increases. In 2030, the amount of additional government expenditures required to achieve the target global HDI of 0.835 increases to USD 3.5 trillion. At the same time, the amount of public finance associated with achieving the target GHG emission reduction also increases, reaching USD 2.9 trillion correspondingly. This increase accounts for the positive association between GDP growth and emissions, which persists at the global level. Still, even with more ambitious HDI and GHG emission targets, opportunities for synergistic action significantly increase in the case of synergy under the intra-sectoral non-fungibility assumption (from 22% in 2025 to 45% in 2030) and slightly increase (from 9% in 2025 to 13% in 2030) in the case of synergy under the intra-sectoral fungibility assumption, respectively.

These results demonstrate that the selected targets are rather ambitious – to achieve a world HDI of 0.835 and a 10% GHG emissions reduction by 2030, requires a substantial increase in government expenditures, i.e., 8.8% beyond the baseline in 2030, where the baseline is estimated using historical shares of sectoral government expenditures to GDP.

The estimates of the global government expenditures associated with the achievement of the HDI and GHG emissions targets computed in this study rest on several key assumptions and available data, which are discussed in greater detail in section 1.4. These estimates are neither projections nor predictions, rather they provide crude estimates regarding the opportunity of synergies to reduce costs of implementation of climate and development action. In some cases, levers other than government expenditures, could be more efficient in fostering development and climate action, such as private investment and development aid, which would reduce the estimates of the government spending associated with the achievement of climate and development goals. In fact, it will be necessary to identify and use more efficient levers to complement government expenditures for the synergistic action to be economically and politically feasible in reality. Our estimates provide a benchmark of how much the action would cost, if it had to rely on government expenditures only and if its efficiency remains as it has been in the past.

It is important to mention how the figures presented in this report are of a different nature and may differ in magnitude compared to other figures being presented and discussed in the intergovernmental process in a similar context. The most quoted figures include those for current climate finance flows of around USD 1.3 trillion per year (2021–2022 average, Climate Policy Initiative 2023), annual investment needs of USD 4.3 trillion per year by 2030 (UNFCCC 2022), USD 6.4 trillion financing gap for SDGs by

FIGURE 3A. Total Government Expenditures, trillion constant 2021 USD, world

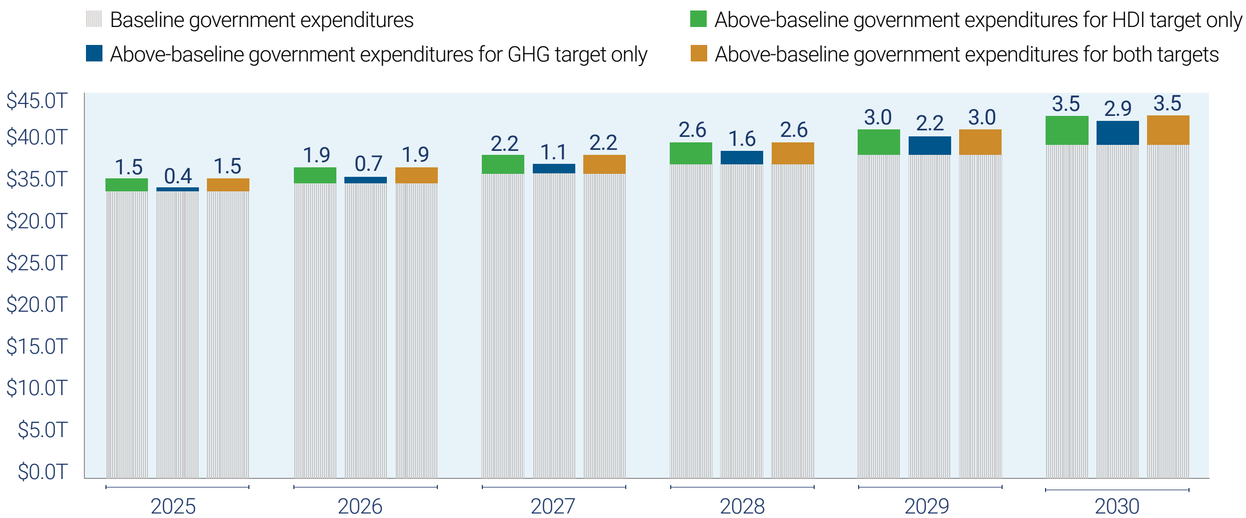
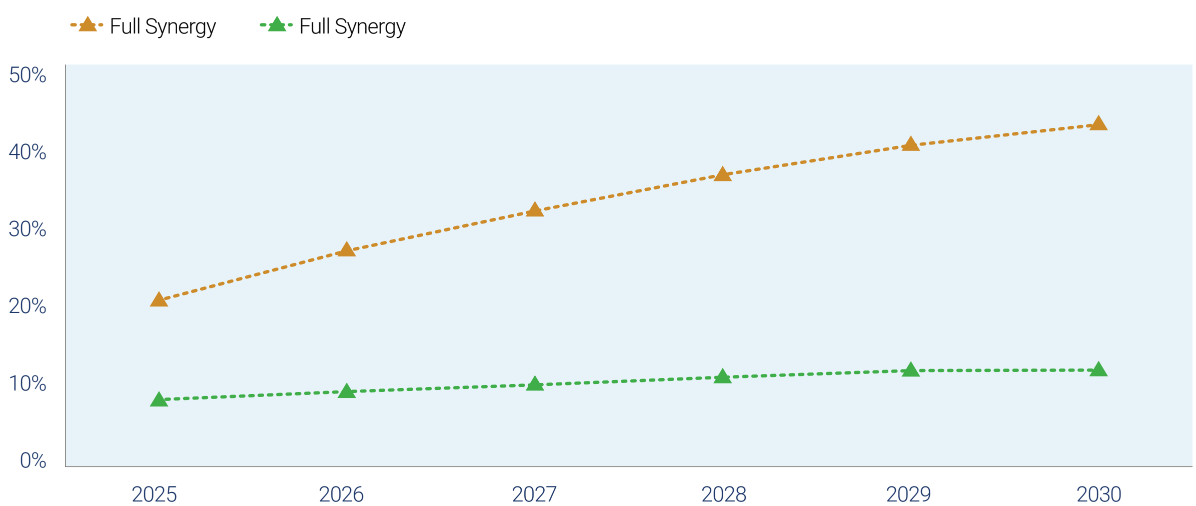


FIGURE 3B. Synergy %



Panel A presents the total expenditures and panel B presents synergies. Grey bars in panel A represent projected baseline government expenditures. Orange and blue bars indicate the additional government expenditures (beyond the baseline) associated with the achievement of the HDI and GHG emission reduction targets, as specified in Figure 1. Light green bars indicate the government expenditures needed to achieve both targets simultaneously, leveraging synergies between the two targets. The violet line in panel B represents the dynamics of synergy under the intra-sectoral non-fungibility assumption, and the green line represents the dynamics of synergy under the intra-sectoral fungibility assumption over the period 2025-2030.

2030 from the OECD or the Climate Policy Initiative's estimate of USD 6 trillion in climate financing required by 2028 to meet a 1.5°C climate target. This is in the context of the primary goal of the Paris Agreement to limit global temperature increase this century well below 2°C above industrial levels, and preferably to 1.5°C. This study is restricted to government expenditures required to meet the HDI and GHG emissions targets specified while other studies estimate direct investments. Moreover, it is not the absolute values which are of most importance but rather reductions (savings) in government expenditure from adopting a synergistic approach.

1.4. Critical assumptions, their limitations and justification

This study has made several critical assumptions including the following.

Limitations and justification of the chosen indicators. This study quantifies synergies between climate and development relying on the Human Development Index as a metric for development and GHG emission reduction as a metric for climate. This study is focused on using one indicator for development and one for climate, as the first step, paving the way for future studies to incorporate a more diverse array of indicators. Clearly, these two indicators capture their intended objectives only partially.

Beyond mitigating emissions, climate adaptation is a critical pillar of climate action. Numerous potential synergies between climate adaptation and development have been proposed, such as enhancing food security through climate-resilient agriculture or reducing disaster risks with improved infrastructure. However, these synergies are often context-specific, depending on local environmental, economic, and social conditions (UNESCAP, 2023).

Development is a multidimensional concept encompassing economic, social, and institutional pillars. While no single metric can fully capture its complexity, the Human Development Index (HDI) remains a widely recognized benchmark, consolidating three core dimensions—education, life expectancy, and income—into a single measure. Although the HDI has limitations—such as excluding inequality, environmental sustainability, and qualitative aspects of progress—its extensive temporal and cross-country data coverage makes it a suitable choice for comparative analysis.

Limitations and justification of the approach. This study aimed to estimate savings from the pursuit of a synergistic approach between climate and development at the global level as one single figure. To achieve this objective, a simple statistical model that directly links government spendings with the progress in development (measured in terms of HDI) and climate (measured in terms of GHG emissions) has been used. The advantage of this approach is that it produces the required estimates without delving into the details of *how* the development and climate action progress is actually made. The model simply assumes that governmental expenditures are linked with progress in development and climate, without specifying the channels through which this link is actually happening. This assumption is supported by the past data. It should also be pointed out that while our model demonstrates potential savings in public finance from synergistic climate-development actions, feasibility of increasing and reallocating government expenditures depends on political and institutional factors beyond the scope of this technical analysis. The magnitude of government expenditures allocations estimated in this report suggests that it is necessary to activate more efficient levers than public finance alone to make the synergistic climate-development action feasible.

The model that was used to compute estimates presented in this report has rather decent statistical quality (measured in R^2 and significance levels of individual coefficients, see Appendix 1 for details), which confirms that the model represents the past data reasonably well and thus can be used for estimating future trends over reasonably short time horizons. Importantly, the statistical model built and used in this study does not claim to diagnose causality – rather it has revealed a statistically significant relation (association) between government expenditures and progress in HDI and GHG emission reduction.

Similar models have been used in previous studies. López *et al.* (2011) developed theoretical and empirical models examining the impact of fiscal spending patterns on environmental quality in 47 countries, finding that reallocating government spending composition towards social and public goods reduces pollution, while increasing total spending without altering composition does not affect environmental outcomes. Halkos and Paizanos (2013) conducted empirical investigations on the relationship between government expenditure and environmental quality for 77 countries using an econometric approach. The established relationships differed according to the countries' income levels. More recently, Guerrero and Castañeda (2022) developed a bottom-up causal framework using data across 140 countries to study the impact of public spending on high-dimensional and interdependent policy spaces in sustainable development contexts, identifying non-linear responses to changes in total government expenditure. These studies collectively demonstrate the potential of econometric modelling approaches to quantify relationships between government spending patterns and sustainable development outcomes.

Limitations and justification of the model choices. This study utilizes a simple linear regression model, where government expenditures across ten COFOG sectors have additive effects (after a log transformation), each with their own weights. Interactions of sectors are not included. Feedback effects of reduced GHG emissions and increased HDI on GDP are not included. The use of log-transformed government expenditures allows including the diminishing returns to scale effects of larger government expenditures. This transformation shows a stronger explanatory power of the past data which confirms this assumption. The use of per capita values for both government expenditures and GDP ensures that the analysis is not skewed by population size and instead focuses on the intensity of economic activity and public investment.

The analysis relies on the Classification of the Functions of Government (COFOG) – a statistical standard developed by the United Nations Statistics Division (UNSD) to categorize government spending based on its purpose. The COFOG classification provides an internationally standardized framework that is widely adopted for statistical reporting. This approach facilitates access to comparable expenditure data across 99 countries, including developed as well as developing and emerging economies. Using these data, data for the missing 79 countries could be imputed (see details in Appendix 1). However, the ten COFOG sectors were not originally designed to align with the Sustainable Development Goals (SDGs) of the 2030 Agenda. This structural discrepancy complicates direct interpretation of the statistical model in relation to SDG-related outcomes. SDG-based budget tagging has emerged as an approach to classify public expenditures according to their direct contributions to specific SDGs (OECD & UNDP, 2019). At this stage, however, its implementation remains limited to pilot cases (UNDP Nepal, 2022), with comprehensive expenditure data not yet systematically available across countries.

Besides government expenditures, other factors may explain progress in HDI and GHG emission reduction. The model used in this analysis includes GDP as a control variable, which demonstrates an exceptionally strong significance as an explanatory variable for both HDI (a positive association) and GHG emissions (a negative association). Other factors such as governance quality or corruption are relevant too, however, data on these factors are much more limited especially their future scenarios that are necessary for determining optimal government expenditures over 2024-2030. The decent explanatory power of regression models used suggests they are sufficient for the purposes of in this study, despite the omission of other potential factors.

While private investment is essential for climate and development objectives, our current global model does not explicitly incorporate it due to, as mentioned, the lack of comprehensive data needed for global modelling. The omission does not imply that costs must be covered solely by public funds. Like many other statistical models, as we pointed out above, the model used in this report provides expenditures estimates without specifying causal pathways. In reality, public spending often catalyses private investment. For example, government R&D funding can enhance the attractiveness of renewables, spurring private sector participation in this industry. While such mechanisms are excluded from our modelling, the results account for them implicitly.

Furthermore, in this model version, spillover effects among countries are not included, that is, the impact of increased government expenditures in one country on the progress in HDI and GHG emission reduction in another country. With the current availability of data, it is technically not possible to include such effects systematically. Effects from specific country pairs could be included at the cost of making additional assumptions. As with the potential inclusion of other control variables, the decent quality of the parsimonious model used in this study justifies the omission of these effects.

Another assumption made in this analysis is that the country’s success in HDI and GHG emission reduction is related to this country’s governmental expenditures in the previous year. Path-dependency over a longer time horizon is not included because the time series available for analysis are rather short and contain significant data gaps.

Limitations and justification of the approach to derive global estimates. While thanks to imputation, the study relies on data of as many as 178 countries, a global-scale model, by its nature, does not capture country-specific heterogeneities in development pathways, institutional capacities, or socioeconomic contexts. Consequently, while useful for identifying broad patterns and global trends, the model's design precludes its direct application to national-level policymaking where context-specific factors are paramount.

2

Quantification of Synergies between Climate Action and SDGs – Cities, Biodiversity, and Finance and Insurance

2.1. Introduction

This section provides key insights from four thematic reports part of the *Synergy Solutions 2025* series to showcase practical entry points for action. It complements the global modelling in Section 1, which presented the benefits of synergistic action in purely quantitative economic benefits. This section highlights the broader impacts of synergies across cities, biodiversity, and finance, quantified in terms of human health and social-wellbeing, nature and biodiversity, and protection of vulnerable people and communities. By showcasing sector-specific evidence, this section offers guidance for targeted interventions and coordinated strategies that can accelerate implementation on the ground. Headline figures are presented here, with full details, case studies, and methodologies available in corresponding thematic reports.

2.2. Cities for Synergistic Climate Action

Urban areas have long been recognized as both a driver of global environmental challenges and a source of innovative solutions to those challenges. Cities may occupy just 2% of the world's land area, but they are where the interactions between people, infrastructure, and the environment concentrate most intensely (UN Habitat, 2020). Home to over half the global population (a share projected to rise to nearly 70% by 2050) urban areas account for over 70% of global CO_2 emissions and two-thirds of energy consumption (IAE, 2021). They are also where the vast majority of the world's-built infrastructure exists, and where human behaviours cluster and spread.

This density, both physical and social, makes cities uniquely positioned to lead synergistic climate action. Retrofitting infrastructure for low-carbon, resilient solutions is more viable and cost-effective in dense urban environments than across dispersed rural landscapes (Ürge-Vorsatz *et al.,* 2012). At the same time, this density can lead to greater exposure to air and other forms of pollution, generating greater benefits when solutions mitigate climate change and reduce pollution (Nemet *et al.,* 2010; Mayrhofer & Gupta, 2016; Karlsson *et al.,* 2020). Similarly, the proximity of individuals within cities enables behavioural change to ripple quickly through networks, amplifying the benefits of sustainable mobility, energy efficiency, and resource circularity.

By focusing climate efforts on cities, we can target the systems (transport, energy, housing, waste) that drive emissions, without requiring disruptive interventions in natural ecosystems. Cities offer a pragmatic, efficient, and equitable pathway to deliver both climate action and sustainable development at scale. This places cities at the centre of global efforts to address climate change while advancing the SDGs. Urban climate actions, if carefully designed and implemented, offer the potential to deliver multiple co-benefits that go beyond emission reductions (LSE Cities, 2016). From improved public health and job creation to enhanced energy security and biodiversity protection, cities must be platforms for synergistic action.

The concept of climate–SDG synergies is well-established in research and international policy processes. However, most of the discussion related to synergies remain framed in qualitative terms, limiting their utility for decision-makers. While phrases such as 'healthier cities,' 'liveable neighbourhoods,' or 'economic opportunities' abound in urban sustainability plans, concrete, city-level evidence that demonstrates the measurable benefits of specific climate actions remains scarce (Creutzig *et al.,* 2024).

Quantification fills this gap. By assigning physical and economic values to the co-benefits of climate interventions, cities can:

- Prioritize actions that deliver the greatest combined climate and development gains
- Build stronger business cases for climate investments
- Secure financing by demonstrating economic returns beyond emissions reductions
- Avoid or limit unintended trade-offs by understanding the multi-dimensional impacts of interventions
- Communicate more effectively with citizens, businesses, and policymakers

Importantly, quantification also helps cities move from aspirational rhetoric to operational decision-making. It enables climate action to be integrated into economic development strategies, health agendas, and social equity policies in a manner that is transparent and accountable. By the same token, quantification can also help integrate socioeconomic development priorities into climate plans.

The quantification of urban synergies is not without challenges. Data gaps, capacity constraints, siloed institutions, methodological limitations, and context-specific variability persist. Many co-benefits, such as improved mental health, biodiversity gains, or social cohesion, remain difficult to measure and monetize but are no less significant (LSE Cities, 2016). Nevertheless, robust quantification efforts provide a critical starting point for more systematic integration of synergies into urban climate action.

Recognizing this, the UN Expert Group Report on Climate and SDG Synergies has sought to make the co-benefits of urban climate action more visible, actionable, and quantifiable (Creutzig et al., 2024). This report presents a narrative overview of the Cities Quantification Table, a flagship output under this initiative. The table systematically compiles physical and economic co-benefits of diverse urban climate interventions, providing a foundation for more integrated and evidence-based city planning (an excerpt of the Table is given in Appendix 2).

The co-benefits of urban climate action can be manifest in two inter-related ways – through direct physical and economic benefits and benefits to public health.

2.2.1 Physical and Economic Benefits of Urban Climate Action

The linkages between urban climate action and the SDGs are shown in the figure below.

Transport

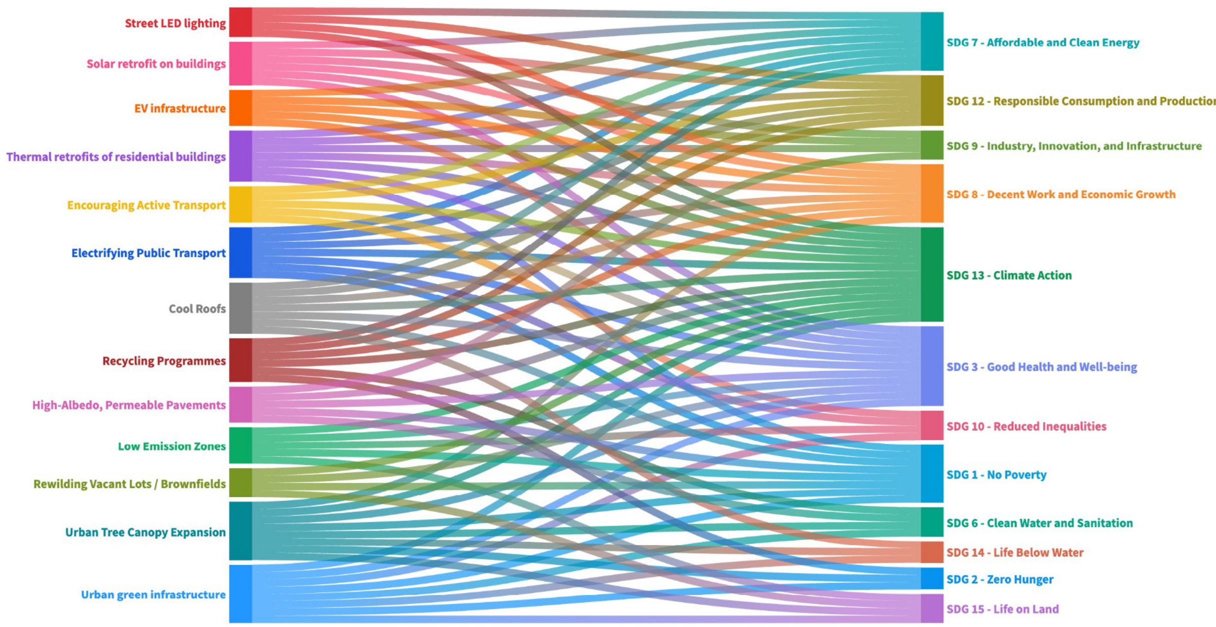
Electrifying Public Transport

Transitioning from diesel to electric public transport offers significant economic, health, and environmental gains. Studies indicate:

- Annual operating cost savings of approximately USD 8,000 per electric bus, primarily through reduced fuel and maintenance expenses
- Health-related externality savings of up to USD 34,000 per bus per year, driven by reductions in air pollutants such as $PM_{2.5}$ and NO_2

FIGURE 4. Urban Climate Actions Drive Multi-SDG Synergies

Mapping the cross-cutting impacts of city-level climate interventions



Each line represents a quantified or literature-backed link between a specific urban climate intervention and a Sustainable Development Goal. SDG 11 not included as it is inherent as the data refers to municipal climate actions.

- Emission reductions of approximately 0.82 kg CO_2 per kilometre for each diesel vehicle replaced
- USD 6,460/year in avoided damages per electric bus (based on SCC @ \$190/tCO_2, EPA 2023)
- USD 22,813/year increase in business revenue per new EV charging station in California (Zheng *et al.*, 2024)

These benefits are particularly significant for cities struggling with air pollution, traffic congestion, and energy insecurity. Electrification of bus fleets also supports job creation and technological innovation in the clean mobility sector.

Encouraging Cycling and Walking (Active Transport)

Promoting active mobility yields substantial health and economic benefits. For example:

- In New Zealand, a modest investment of NZD 130,000 in active transport infrastructure generated health benefits valued at over NZD 2.1 million, yielding a benefit–cost ratio of 11:1 (Chapman *et al.*, 2018)
- Per-kilometre savings—including reduced congestion, fuel use, and health costs—are estimated at AUD 1.12–1.68 in the Australian context (Mulley *et al.*, 2013)
- Building 100 km bicycle networks in cities, urban transport sector GHG emission savings at the order of 4%–19% are possible (Creutzig *et al.*, 2022)

- In Nashville (United States), three active transport scenarios involving walking/bicycling as well as reductions in car travel could reduce 24 to 123 deaths and save USD 10-63 million per year (Whitfield *et al.*, 2017)
- For urban areas outside of London, walking and cycling scenarios were estimated to avoid between approximately 3,700 and 8,500 disability adjusted years by 2030 (Woodcock *et al.*, 2013)
- Increased walking and cycling in Delhi could reduce 4080 premature deaths while mitigating more than 700,000 tons of CO_2 tons and generating nearly one billion in cost savings annually (Bhat & Farzaneh, 2022)

Modal shifts to walking and cycling contribute to improved cardiovascular health, reduced greenhouse gas emissions, and enhanced urban liveability. Active transport interventions also deliver co-benefits for social equity, providing affordable mobility options for lower-income communities.

Low Emission Zones (LEZs)

Low Emission Zones reduce traffic-related air pollution while generating significant economic savings. Studies show:

- 10–44% reduction in roadside NO_2 levels across European cities (Schucht *et al.*, 2015)
- 15–55% reduction in traffic-related $PM_{2.5}$ and black carbon emissions (Sabel *et al.*, 2016)
- Health-related economic benefits of €120–475 million per city, per year, from improved air quality and reduced disease burden (Schucht *et al.*, 2015)

LEZs also reduce congestion and noise, contributing to safer, healthier, and more attractive urban environments.

Buildings, Energy, Industry and Waste

Cool Roofs

Cool roofs—designed with reflective materials to reduce heat absorption—offer significant potential for energy savings and climate resilience. Studies indicate:

- Energy cost reductions of 20–62% for buildings fitted with cool roofs (Sharifi, 2021)
- System-wide energy demand reductions of up to 70% when combined with ventilation and shading (Macintyre & Heaviside, 2019)
- Net present value of large-scale cool roof retrofit programs exceeding USD 4.4 billion across major cities (Sharifi, 2021)
- Estimated energy cost savings of ~$USD 1.3–1.4/m²/year in Hyderabad commercial buildings (2012 data) (Xu *et al.*, 2012).
- Avoided greenhouse gas emissions valued at USD 25–55 per square meter over 20 years, based on social cost of carbon estimates (Macintyre & Heaviside, 2019)

Cool roofs also contribute to urban heat island mitigation, reducing health risks during extreme heat events and enhancing thermal comfort in vulnerable communities.

Solar Rooftop Retrofits

Rooftop solar installations are a cornerstone of urban decarbonization efforts, delivering both economic and environmental benefits:

- Generation of 1,200–2,000 kWh of electricity annually per household, depending on system size and location
- Household electricity cost reductions of 30–80%, enhancing energy security and affordability (Eikeland *et al.,* 2023)
- Levelized costs of electricity as low as USD 66/MWh in high-solar regions (Bódis *et al.,* 2019)
- Lifetime household savings of €4,500–€10,000 over 25–30 years (Bódis *et al.*, 2019)

Solar rooftop programs also support local job creation in installation, maintenance, and energy services.

Thermal Retrofits of Residential Buildings

Retrofitting residential buildings for improved thermal performance delivers substantial public health and economic returns. Studies indicate:

- Avoided health costs ranging from USD 53 to USD 9,440 per person annually, largely due to reduced indoor air pollution and improved thermal comfort (Ruiz-Valero *et al.,* 2025)
- Job creation potential of 1,022 to over 67,000 jobs, depending on retrofit scale and program design (Ruiz-Valero *et al.,* 2025)
- High performing buildings in Japan can reduce energy intensity by 33% and 26%, lower CO_2 emissions intensities by 38% and 32% relative to benchmark values while saving USD 1–1.5 million annually per building (Balaban & Puppim de Oliveira, 2016)

Thermal retrofits also reduce energy consumption, lower winter mortality rates, and improve energy security, particularly for vulnerable populations.

Industrial Energy Savings and Energy Efficiency

Conserving energy and improving efficiency in industries can lower pollution levels and improve health while mitigating climate change. Studies suggest:

- Energy conservation reforms in Baoshan industrial zone in Shanghai were estimated as leading to a reduction of nearly 8% in particulate matter emissions while reducing energy intensity by more than 25% (Jiang, 2016)

Sustainable Waste Management and Circular Economy

Reducing the waste streams through more integrated waste management and circular economy models can increase resource efficiencies, save energy and lower emissions of methane and CO_2. Studies indicate:

- An integrated waste management system (focused on recycling) in Muangklang Municipality (Thailand) has the potential to reduce GHGs (both methane and CO_2) by between 17% and 60% relative to a sanitary landfill and open dumping scenario (Menikpura *et al.,* 2013)

Urban Nature and Land Use

Urban Tree Canopy Expansion

Expanding urban tree canopy delivers multiple measurable co-benefits. Studies show:

- Urban air temperature reductions of 0.5–2.0°C on average, with localized reductions of up to 9.4°C (Bai et al., 2024; Scholz *et al.,* 2018)
- Cooling-related electricity savings of USD 155 million annually in Phoenix, USA following a 5% vegetation increase (Middel *et al.,* 2015)
- Avoided health costs from air pollution removal estimated at USD 1.2 million annually in Strasbourg (Pascal *et al.,* 2019)

Additional benefits include improved mental health, biodiversity conservation, and stormwater management. Tree canopy expansion is among the most cost-effective and socially beneficial urban climate actions, with benefits extending across sectors.

2.2.2 Public Health Benefits of Urban Climate Action

The intersection of climate mitigation and public health in urban environments offers transformative opportunities. Cities are at the epicentre of both climate challenges and health opportunities. Rapid urbanization, coupled with high energy consumption and transport activity, has made urban centres significant contributors to greenhouse gas emissions, while simultaneously exacerbating health issues such as air pollution, heat stress, and sedentary lifestyles. However, these challenges present a unique opportunity: actions to mitigate climate change often have immediate and measurable health co-benefits. For example, replacing fossil fuel energy sources with renewables not only reduces carbon emissions but also improves air quality, preventing respiratory and cardiovascular diseases. Similarly, promoting active transport like walking and cycling lowers emissions and simultaneously enhances physical activity, reducing the prevalence of non-communicable diseases such as diabetes and obesity. Quantified evidence shows that integrated urban actions—particularly in transport, energy, diet, and urban form—can yield significant co-benefits, including reductions in premature mortality, years of life lost (YLL), and greenhouse gas (GHG) emissions. Some of the headline figures are presented below.

Quantified Co-Benefit Pathways

There are three principal quantified pathways of climate-health co-benefits:

1. ***Air Pollution Reduction via Fossil Fuel Phase-Out.*** Air pollution from fossil fuels is a major global health hazard, contributing to millions of premature deaths annually. Phasing out fossil fuels, especially coal, reduces ambient concentrations of particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), black carbon, and tropospheric ozone—pollutants linked to ischemic heart disease, stroke, chronic respiratory conditions, and diabetes. Modelled estimates indicate that:

   - Achieving Nationally Determined Contributions (NDCs) in nine countries could prevent 1.2 million premature deaths annually by 2040
   - Full implementation of black carbon and methane reduction measures could prevent 4.7 million deaths and reduce global warming by 0.5°C by 2050
   - In India, decarbonizing electricity could yield up to 182 YLL avoided per 100,000 people per year, vastly exceeding benefits observed in lower-pollution regions like the European Union (EU) (10 YLL per 100,000)

2. ***Dietary Shifts Toward Plant-Based Diets.*** Shifting to predominantly plant-based diets—low in red meat and dairy, high in fruits, vegetables, and whole grains—has dual benefits: reduction in diet-related non-communicable diseases (NCDs) and decreased agricultural emissions. Specifically, adoption of such diets could:

   - Prevent 10–11 million deaths annually by 2040
   - Cut agricultural GHG emissions in half and reduce deforestation by 20% between 2030 and 2050
   - Provide a median health gain of 306 YLL avoided per 100,000 annually

3. ***Active Travel and Public Transport.*** Inactivity causes 5 million deaths yearly worldwide. Promotion of active transport (walking, cycling) and public transit enhances physical activity and reduces the burden of non-communicable diseases, especially cardiovascular diseases. In urban contexts, these measures are the most feasible and cost-effective ways to raise physical activity levels.

   - A case study from New Plymouth, New Zealand (NZ): showed that increased walking and cycling infrastructure resulted in a reduction of 1,150 tonnes of carbon dioxide (CO_2) and avoided 34 DALYs and two deaths over two years
   - Actions in India, where the burden of physical inactivity and air pollution is high, showed the greatest health co-benefit intensity, up to 60 YLL per 100,000 population per year

Sector-Specific Quantitative Insights

Here we summarize evidence of synergetic options in five urban sectors—electricity generation, buildings, waste, food, and urban form, analysing both mitigation and adaptation efforts.

1. Electricity Generation

- Transitioning from coal to renewables offers a median reduction of 171 kilotons of carbon dioxide equivalent ($ktCO_2e$) per 100,000 people/year, with health benefits of 149 YLL per 100,000 in India vs. 10 YLL in the EU
- Clean cookstoves yield 1,279 YLL avoided per 100,000/year with modest emissions mitigation

2. Urban Transport

- Congestion charges reduce traffic by ~10–20% and CO_2 emissions by up to 16%.
- In London, 1,888 life-years were gained post-implementation; Stockholm saw 50% fewer asthma attacks in children
- Public transport (*e.g.,* Mexico City Bus Rapid Transit (BRT)): $PM_{2.5}$ and NO_2 reductions; up to 50% crash injury reduction on corridors
- Cycling infrastructure: modal shifts (+48% in some cities), ~1–2% CO_2 reduction short-term; substantial reductions in all-cause mortality
- Electrification: Hospitalizations (*e.g.,* asthma) decreased 10–20%; large-scale fleet transitions in Delhi or Beijing could save thousands of lives annually

3. Buildings and Indoor Air Quality

- Retrofitting (NZ's Warm-Up program): 10% reduction in new chronic respiratory diagnoses; 9.3 fewer respiratory hospital admissions per 1,000 people. Energy retrofits in 205,000 homes improved respiratory health and lowered medication use (4–7% reductions)
- Cool roofs in India and Africa: indoor temps ↓1–2°C; indirect reductions in cooling energy demand
- Clean cooking transitions (*e.g.,* Household Air Pollution Intervention Network (HAPIN) trial): ~50% reduction in $PM_{2.5}$ exposure but limited immediate health outcome changes

4. Waste Management

- Improving basic waste collection and ending practices like open dumping and burning reduces disease incidence and eliminates major sources of methane and toxic smoke
- Source-separated composting and anaerobic digestion cut GHG emissions and improve sanitation
- Methane capture at landfills provides potent climate benefits and removes toxic pollutants.
- Waste-to-energy incineration offers volume reduction and controlled destruction of waste

- Circular economy approaches that prioritize waste reduction, reuse, and material recovery show great promise in achieving deep emissions cuts and a range of co-benefits, from cleaner neighbourhoods to green job creation and environmental justice

5. Urban Form

- A Latin American study of 370 cities showed better connectivity and compactness associated with lower GHGs and chronic disease rates
- China's low-carbon city pilot reduced mortality in polluted cities
- A study of urban greening in 93 European cities showed that increasing tree cover to 30% would reduce summer deaths by 2,644 (~0.4°C cooler cities)
- A meta-analysis (59 studies) showed that increased access to green space was linked to ~9% lower odds of developing psychiatric disorders

2.2.3 Insights and Key Messages

The quantification exercise reveals that many urban climate actions offer benefits that significantly exceed their direct costs. In several cases, monetized co-benefits alone justify the intervention, even without considering avoided greenhouse gas emissions.

Key insights include:

- Health co-benefits—particularly from improved air quality and increased physical activity—represent some of the largest monetized synergies
- Energy savings, avoided fuel use, and enhanced resilience deliver substantial economic returns
- Many actions, such as cool roofs and tree canopy expansion, offer rapid payback periods and long-term benefits
- Difficult-to-monetize co-benefits, including mental health improvements, biodiversity gains, and social cohesion, should not be neglected in decision-making

The evidence compiled in the Cities Quantification Table underscores the critical role of cities as platforms for synergistic climate and development action. For city leaders, urban planners, and policymakers, this evidence supports the following key messages:

- Integrated climate actions deliver significant, measurable co-benefits that advance multiple SDGs
- Quantification helps build stronger business cases for climate investments and unlock financing opportunities
- Policymakers should prioritize no-regrets interventions with proven, high-value synergies

- Data gaps, particularly around biodiversity, mental health, and social equity co-benefits, should be addressed through targeted research
- Cities should embed quantification frameworks into planning processes, monitoring systems, and climate reporting
- At the international level, these findings reinforce the need for national governments and development partners to support cities in scaling synergistic climate actions. NDCs, National Adaptation Plans, and climate finance mechanisms should explicitly recognize and incentivize urban co-benefits

2.2.4 Recommendations

In summary, cities can take the following actions to realize co-benefits of urban climate action, following the three pathways, and integrated action via urban form.

Active Travel: Cities should prioritize infrastructure supporting walking, cycling, and efficient public transportation. Key actions include expanding networks of safe bike lanes, creating pedestrian-friendly urban zones, and implementing car-restriction policies. Such initiatives simultaneously reduce greenhouse gas emissions, enhance physical activity, lower chronic disease rates, and improve mental health (Nieuwenhuijsen *et al.,* 2020).

Air Quality: Improving urban air quality requires stringent policies to reduce traffic emissions, shift towards electric vehicles powered by renewable energy, and implement clean-air zones. It also entails clean cooking standards to combat indoor air pollutions. Enforcing World Health Organization (WHO)-aligned air quality standards can rapidly reduce respiratory and cardiovascular diseases, significantly lowering premature mortality rates alongside cutting emissions (Khomenko *et al.,* 2021).

Plant-Based Diets: Promoting shifts towards predominantly plant-based diets can reduce urban greenhouse gas footprints significantly. Actions include public awareness campaigns, integrating sustainable diet standards in city procurement policies, and providing incentives for restaurants and food outlets. Dietary transitions simultaneously lower emissions, reduce chronic health risks, and enhance urban food system resilience (Willett *et al.,* 2019).

Heat-Resistant Urban Form: Cities should adopt urban designs that mitigate heat, such as increased tree coverage, green roofs, reflective surfaces, and enhanced urban green spaces. These nature-based and reflective solutions decrease urban heat islands, reduce heat-related morbidity and mortality, and contribute to local climate mitigation by lowering energy demands for cooling (Iungman *et al.,* 2023).

National governments and international organizations can support municipalities in advancing these strategic actions for maximizing co-benefits and fostering healthier, more sustainable urban environments.

2.2.5 Conclusions and Next Steps

The quantification of urban climate–SDG synergies is a critical tool for more integrated, effective, and equitable climate action. By making the economic and physical co-benefits of urban interventions visible and measurable, cities can better align their climate strategies with development priorities and unlock much-needed resources for implementation.

Moving forward, the following actions are recommended:

- Engage with City Labs to test, refine, and localize co-benefit quantification in diverse urban contexts
- Advocate for the integration of quantification approaches into national and sub-national climate policies and financing frameworks
- By embracing a quantified, evidence-based approach to urban climate action, cities can position themselves at the heart of a more sustainable, resilient, and equitable global future

2.3 Nature Conservation and Biodiversity

The Convention on Biological Diversity (CBD), the Convention to Combat Desertification (UNCCD), and the United Nations Framework Convention on Climate Change UNFCCC are interlinked global frameworks addressing biodiversity loss, land degradation, and climate change, respectively. The three frameworks underscore the pivotal role of ecosystems in maintaining biodiversity and regulating the climate. Healthy ecosystems—particularly forests, wetlands, peatlands, and marine habitats—not only sequester carbon but also provide essential ecosystem services with quantifiable benefits across multiple sectors. The integration of nature-based solutions (NbS) into climate strategies shows clear potential for achieving cost-effective mitigation, while generating biodiversity, health, and socio-economic co-benefits.

2.3.1 Quantified Carbon Sequestration Potential of Ecosystems

Several ecosystems are especially vital in the global carbon cycle, offering massive mitigation and adaptation potential through protection, restoration, and sustainable management:

- Forests: Tropical forests are critical repositories of global carbon; living tropical trees are estimated to hold 200–300 Pg C or about one-third of the levels in the atmosphere (Mitchard, 2018)
- Peatlands: Covering 3% of land, peatlands store 550 Gt carbon globally, with degraded peatlands being responsible for 5% of global CO_2 emissions (IUCN, 2021)
- Blue Carbon Ecosystems: Blue carbon in mangroves represents one of highest values of carbon stocks per hectare. Conserving remaining mangroves would avoid the release of up to 15.51 $PgCO_2$ to the atmosphere. Restoring mangroves can sequester up to 0.32 $PgCO_2$ globally (Jakovac *et al.,* 2020)
- Disaster Risk Reduction: Mangroves prevent USD? 65 billion/year in flood damage (Menéndez *et al.,* 2020)
- Water Security: Forest conservation improves water quality and water security, reducing treatment cost (Caldwell *et al.,* 2023)

2.3.2 Decline of biodiversity and its impacts

Over half of global GDP (USD 58 trillion in 2023) is moderately or highly dependent on nature (Evison *et al.,* 2023; Herweijer *et al.,* 2020). Yet funding for conservation is under 1% of global GDP, with just USD 200 billion/year invested, leaving a gap of USD 300 billion to USD 1 trillion annually (Deutz *et al.,* 2020). Additionally, the extra investment required to achieve the SDGs most directly related to water, food, health, and climate change is at least USD 4 trillion annually. However, the cost of addressing biodiversity loss could double if action is delayed by a decade (*e.g.,* from 2021 to 2030). Additionally, at least USD 500 billion more per year would be needed to tackle climate change. Exposure to climate change risks could double between a global warming level of 1.5°C and 2°C and double again between 2°C and 3°C, severely impacting multiple sectors (Byers, 2018).

The recently released Thematic Assessment Report on the Interlinkages among Biodiversity, Water, Food and Health of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (IPBES, 2024), indicated that over the past 30 to 50 years, all evaluated indicators point to a biodiversity decline of 2% to 6% per decade. Since 2001, ten out of twelve key indirect drivers of biodiversity loss have intensified, amplifying the impacts of direct drivers.

- Over the past 30-50 years, all evaluated indicators point to a biodiversity loss of 2–6% per decade
- One-third of coral reefs are in decline, which could affect 1 billion people and threaten the loss of reef ecosystems in 10–50 years
- Air and water pollution caused 9 million premature deaths in 2019—16% of all global deaths

There is a misalignment of economic and financial decisions that harm biodiversity and consequently, climate integrity, as biodiversity loss and climate change reinforce each other, reducing ecosystem resilience and affecting all interconnected elements.

- Environmentally harmful subsidies (implicit and explicit) and investments total USD 7 trillion per year (Damania *et al.,* 2023)
- Fossil fuel, agriculture, and fishing industries cause externalities estimated between USD 10–25 trillion/year (McElwee *et al.,* 2024)
- Harmful private financial flows reach USD 5.3 trillion/year; public subsidies total USD 1.7 trillion/year (Garasimchuk *et al.,* 2025)
- Illegal resource extraction alone contributes USD 100–300 billion annually to biodiversity degradation (IPBES, 2024, McElwee *et al.,* 2024)

2.3.3 Ecosystem Services and Quantified Contributions to SDGs

Ecosystem services (ES), the benefits humans derive from nature, are foundational to achieving the SDGs. Protecting and restoring these services can simultaneously advance climate resilience, poverty reduction, biodiversity, and human well-being. Table 1 presents a synthesis of key synergies, supported by quantitative and qualitative evidence, while Table 2 shows cross-cutting co-benefits and quantitative synergies.

TABLE 1. Direct Contributions of Ecosystem Services to SDGs

Ecosystem Service	Linked SDGs	Key Synergies
Provisioning Services (*e.g.*, food, water, raw materials)	2 ZERO HUNGER; 6 CLEAN WATER AND SANITATION; 7 AFFORDABLE AND CLEAN ENERGY	Agriculture depends on pollination (valued at USD 235–577 billion/year globally) (IPBES, 2016). Forests supply 75% of accessible freshwater for cities and agriculture (UN, 2021).
Regulating Services (*e.g.*, climate regulation, flood control)	3 GOOD HEALTH AND WELL-BEING; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION	Coastal wetlands avert USD 65 billion/year in flood damages (Herrera-Silveira, 2020). Forests sequester ~30% of annual CO_2 emissions (Harris *et al.*, 2021) Peatlands sequester ~0.4 billion tons of CO_2 annually (Joosten, 2010).
Supporting Services (*e.g.*, soil fertility, nutrient cycling)	12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 15 LIFE ON LAND	Healthy soils boost crop yields by 20–30% (FAO, 2022), critical for food security (SDG 2).
Cultural Services (*e.g.*, recreation, spiritual value)	4 QUALITY EDUCATION; 8 DECENT WORK AND ECONOMIC GROWTH	Nature-based tourism generates USD 343 billion/ year globally, providing 21.8 million jobs and supporting education (WTTC, 2022). Payments for ecosystem services have mobilized up to USD 42 billion per year from public and private sources (IPBES, 2024).

TABLE 2. Cross-cutting co-benefits of Sustainable Development Goals (SGDs) and quantitative evidence of synergies.

SDGs	Cross-cutting co-benefits
13 CLIMATE ACTION; 15 LIFE ON LAND	Restoring 30% of terrestrial and marine ecosystems could safeguard 500 $GtCO_2$ in carbon stocks and prevent 60% of projected species extinctions (Strassburg *et al.*, 2020)
1 NO POVERTY; 3 GOOD HEALTH AND WELL-BEING	Mangrove conservation in Southeast Asia supports 15 million people with fisheries and storm protection, reducing poverty and disaster risks (Spalding *et al.*, 2021). 56 - 57% of the global ecosystem service value (ESV) that benefits the world's poorest people originates from areas identified as high priorities for biodiversity conservation (Turner *et al.*, 2012). More than 60 thousand species of plants, animals, fungi, and microbes are used to produce medicines (Landrigan *et al.*, 2024).
5 GENDER EQUALITY; 6 CLEAN WATER AND SANITATION	Women in rural areas spend 200 million hours/day collecting water; restoring watersheds reduces this burden (UN Women, 2023)
	Quantitative Evidence of Synergies
2 ZERO HUNGER	Conservation agriculture results in an average 21% increase in soil health and supports similar levels of crop production after long-term warming compared to conventional agriculture (Teng *et al.*, 2024).
7 AFFORDABLE AND CLEAN ENERGY	Sustainably managed forests provide 40% of global renewable energy (biomass), reducing reliance on fossil fuels (FAO, 2018)
14 LIFE BELOW WATER	Coral reefs support 25% of marine species and provide USD 2.7 trillion/year in goods/services (Souter et *et al.*, 2021).

2.3.4 Economic Quantification of Nature-Based Solutions and Ecosystem Services

Nature-based solutions refer to actions to protect, sustainably manage, and restore natural and modified ecosystems. They address major challenges such as climate change, disaster risk reduction, food and water security, biodiversity loss, and human health, and are critical for achieving sustainable development.

Nature-based solutions have demonstrated exceptional cost-effectiveness, especially when benefits are viewed through a long-term, global lens. Moreover, ecosystem services in biodiversity-rich areas can be 326% more valuable than the opportunity costs of conserving them (Turner *et al.,* 2012). Specifically:

- Nature-based solutions could deliver up to 37% of the cost-effective CO_2 mitigation needed by 2030 (Griscom *et al.,* 2017)
- Restoring 350 million hectares of degraded land by 2030 could provide USD 9 trillion in ecosystem services
- Nature-based solutions are often more economical than engineered alternatives in moderate-risk contexts
- Investment of USD 8.1 trillion in nature-based solutions by 2030 could yield 395 million new jobs

2.3.5 Climate action and biodiversity

Recent research highlights the potential for synergies between biodiversity conservation and climate action. Nature-based solutions play a key role in addressing both crises simultaneously (FANC, 2023). Implementing climate mitigation strategies with biodiversity considerations can lead to 'win-win' outcomes, such as increasing offshore wind capacity and rehabilitating natural areas around onshore turbines (Gorman *et al.,* 2023). The contribution of nature to climate change mitigation can strengthen links between international biodiversity and climate agreements (De Lamo *et al.,* 2020). One promising approach is utilizing biomass from protected areas for bioenergy production. For instance, non-forest ecosystems in Natura 2000 could produce 17.9 Gt of dry biomass annually, potentially avoiding 12.5 $GtCO_2$ equivalent emissions and 1.2-2.8 million ha of indirect land-use change (Van Meerbeek *et al.*, 2016). These synergies offer opportunities to address both biodiversity loss and climate change effectively.

2.3.6 The Role of Indigenous Peoples and their Territories

Extensive scientific evidence highlights the vital role of Indigenous Peoples in safeguarding global biodiversity while ensuring ecosystem services and mitigating climate change. Indigenous Peoples and their territories host a significant share of the world's remaining biodiversity and overlap with nearly 40% of all protected terrestrial areas and ecologically intact landscapes (Garnett *et al.*, 2018; Nitah, 2021). In regions such as Latin America and the Caribbean, studies show that when Indigenous Peoples have secure land rights, their territories store more carbon, maintain denser forests, and support greater biodiversity compared to lands managed by other actors (FAO & FILAC, 2021).

Recognizing Indigenous territorial rights and integrating Indigenous and local knowledge (ILK) into conservation strategies are proven, cost-effective approaches for reducing deforestation and enhancing land stewardship, both essential for meeting global biodiversity and climate goals.

2.3.7 Conclusion: A Case for Integration

Quantitative evidence overwhelmingly supports the integration of biodiversity conservation and climate action. Synergistic investments yield high returns in avoided damages, ecosystem services, climate mitigation, and job creation. Policy frameworks should prioritize:

- Embedding biodiversity in climate plans (*e.g.,* NDCs)
- Aligning international biodiversity and climate frameworks (*e.g.,* Global Biodiversity Framework (GBF) and Paris Agreement)
- Removing and redirecting harmful subsidies
- Expanding finance for Indigenous Peoples and local communities
- Adopting context-specific, cross-sectoral approaches to maximize benefits and minimize trade-offs

The numbers are clear: integrating nature and climate is not only ecologically essential but economically rational.

2.4 Preserving the Insurability of Vulnerable Populations to Close the Protection Gap

In 2023, economic losses from natural catastrophes totalled $290 billion, with 62% of global losses remaining uninsured. In high-income countries, about half of reported economic losses from climate-related events were insured, whereas in Africa, only 0.5% of losses had coverage. As the climate crisis intensifies, uninsured global losses could double by 2030, reaching $560 billion. Certain regions and businesses may become effectively 'uninsurable'—either due to the complete absence of insurance options or because coverage is inadequate, inaccessible, or prohibitively expensive. Unmitigated climate change could lead to annual economic losses between $7 trillion and $38 trillion by 2050.

Closing the climate and disaster insurance gap is essential to accelerate progress on the Sustainable Development Goals (SDGs) and reduce the protection gap. According to some estimates, a 1% increase in insurance coverage moves countries 5.8% closer to achieving SDGs. Insights from literature and case studies highlight five key strategies to address the climate and disaster insurance protection gap:

2.4.1 Integrating disaster risk financing into national development

A national disaster risk financing strategy can significantly reduce reliance on post-crisis emergency aid by securing funding before disasters strike. Governments can optimize financial protection by layering risk retention mechanisms (such as contingency funds, budget allocations, and credit lines) with risk transfer instruments (including insurance and catastrophe bonds). Shifting from reactive (ex-post) responses to proactive (ex-ante) financing solutions allows for faster crisis response, minimizing economic disruption.

Despite the benefits of pre-arranged financing, only 2% of the $76 billion spent on disaster crisis financing in 2022 was pre-arranged. Recognizing this gap, the High-Level Panel on Closing the Crisis Protection Gap has urged that the proportion of pre-arranged international crisis finance increase tenfold over the next decade. However, only 30 countries have developed standalone disaster risk financing strategies, despite escalating climate risks.

2.4.2 Incentivising insurance offer and uptake

Insurance penetration remains low in many countries due to structural barriers such as limited access to long-term affordable capital, fragmented market regulations, weak enforcement capacity, lack of data, and low consumer awareness. Additionally, the predominance of informal economies and small insurance market sizes further hinder expansion.

The optimal mix of policies and financial tools to overcome these barriers varies across communities, industries, and countries, as well as different stages of insurance market development. To optimize the deployment of scarce public resources, a risk instrument ladder approach is proposed to close the insurance protection gap. This includes: (i) regulatory measures to incentivize and de-risk insurance uptake and offer; (ii) premium and capital support to increase affordability and availability of disaster insurance; (iii) alternative risk transfer mechanisms; (iv) national public (re)insurance schemes; (v) regional catastrophe risk pools; and (vi) global umbrella GDP stop-gap mechanisms.

2.4.3 Encouraging investment in risk reduction and prevention

Investing in risk prevention and reduction can be up to 10 times more effective than rebuilding. Governments play a critical role in promoting risk-informed development and addressing the underlying vulnerabilities that transform hazards into disasters. For instance, between 1970 and 2010, the number of people living in flood plains increased by 114%, while those in cyclone-prone coastal areas grew by 192%, a trend expected to continue in the coming years in the absence of regulatory interventions.

Insurance pricing models should incentivize proactive risk reduction by offering lower premiums for resilience-building investments. However, policyholders worldwide are not consistently rewarded for their preventive measures. Some jurisdictions are experimenting with legislation requiring insurers to provide discounts to homeowners who enhance their properties' resilience against natural hazards. Governments can further support risk reduction by integrating prevention into insurance pricing through improved data provision. They can also help policyholders manage upfront costs for resilience investments by offering concessional capital or financial incentives.

2.4.4 Developing inclusive insurance solutions to leave no one behind

Vulnerable populations often struggle to access traditional insurance markets. Inclusive insurance mechanisms—such as microinsurance and parametric models—offer tailored coverage for low-income households and small businesses, ensuring financial protection without excessive premium costs. In 2022, microinsurance covered 330 million people across 36 countries, generating $5.8 billion in premiums. While many innovations in this space are still in the early stages of commercial success, some pioneering schemes are proving the scalability and sustainability of microinsurance business models. For instance, the Zambian Farmer Input Support Programme (FISP), launched in 2002, insured over 1 million farmers in 2024 while providing $38 million in payouts.

Despite this progress, microinsurance accounts for only 15% of the estimated market size. As for macro- and meso-insurance solutions, regulatory instruments can help accelerate the uptake of micro-insurance. Notably, governments can mandate transparency in insurance contracts to build consumer trust, develop proportionate regulatory frameworks (*e.g.,* reduced capital requirements for microinsurance providers) and integrating inclusive insurance into national resilience strategies to provide long-term market visibility.

2.4.5 Fostering adaptive social security systems

When developing a Disaster Risk Financing Strategy, money-out systems should be designed alongside money-in instruments to ensure efficient fund distribution. Social protection systems could play a crucial role in ensuring that mobilized funds are delivered swiftly, transparently, and effectively. However, synergies between disaster risk financing and social protection remain underutilized.

Currently, ex-ante disaster financing instruments rarely require specific spending plans, and insurance payouts are seldom channelled through social protection schemes. To address this gap, innovative mechanisms are emerging. One example is the WFP Caribbean's top-up model, which provides governments with additional funding to top up a portion of the payout. These funds are allocated for cash assistance to vulnerable populations affected by disasters through national social protection programs.

2.4.6 A roadmap to optimise synergies between disaster insurance protection and the SDGs

Successfully closing the climate and disaster insurance protection gap will require sustained, coordinated efforts from a broad range of stakeholders. The paper presents a multi-stakeholder roadmap to implement its key recommendations and enhance synergies between disaster insurance protection and the SDGs. Integrating insurance more prominently into development agendas can help drive and sustain these efforts, ensuring resilience against future climate and disaster risks.

Quantifying the cost effectiveness of closing the climate and disaster investment gap is an evolving field. The cost will depend on various factors, including (i) the respective exposure and vulnerability of geographic regions; (ii) the type of policy and financial instruments deployed to incentivize the uptake and offer of ex-ante disaster financing instruments; (iii) the capacity to encourage risk reduction and prevention; (iv) the development of innovative insurance products to respond to evolving threats and to reach out to underserved population; and (v) opportunities to capitalize on existing social infrastructures such as social protection systems to release funds in a timely and efficient manner. However, direct extrapolation from existing initiatives would indicate that an investment of $15-25 billion could provide coverage to an additional 3 billion people.

2.5. Conclusion

It is clear from the discussion above that the benefits from a synergistic approach to addressing climate and sustainable development cannot, and indeed must not, be viewed in merely economic terms. As expected from adopting an integrated approach, the benefits derived are complex and multi-dimensional. By its nature, sustainable development is not simply an economic issue – the same can be said for climate change. As we have seen, issues such as public health, social cohesion, nature and biodiversity, and protection of vulnerable people and communities are integral components of sustainable development that are all impacted by climate change. Although the benefits of achieving these outcomes might not always lend themselves to rigorous economic quantification and valuation, it is clear from the above that they can be quantified and clearly show the multiplicative advantages of an integrated and synergistic approach.

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4 | Appendices

Appendix 1. Data Imputation, Mathematical Basis of Models, and Scenario Calculations

COFOG expenditures – imputation

Combing data from IMF and UNCTAD, government expenditures data were split into ten COFOG sectors: 1) general public services; 2) defence; 3) public order and safety; 4) economic affairs; 5) environmental protection; 6) housing and community amenities; 7) health; 8) recreation, culture and religion; 9) education; and 10) social protection were available for 178 countries including 39 advanced and 139 developing and emerging economies for 1995-2023.

To fill in data gaps, sectoral government expenditures for the missing countries were imputed by using the following multi-step process:

1. Country-level mean fill: For years where data only for some COFOG sectors were available for a country, missing sectors were filled using that country's average share of GDP for that category, calculated over the years where full COFOG data were reported:

   $$s_{c,t,j} = \frac{1}{|Y_c|}\sum_{t' \in Y_c} s_{c,t',j}$$

   where $s_{c,t,j}$ and $s_{c,t',j}$ are the share of government expenditures of country *c* in years *t* and *t'* in COFOG category *j*, Y_c is the set of years, and $|Y_c|$ is the number of years in this set. Missing per capita COFOG expenditures were estimated as

   $$pcGovExp_{c,t,j} = s_{c,t,j} \cdot pcGDP_{c,t}\cdot$$

2. Linear interpolation: Any remaining gaps within a country's time series for a given COFOG category were filled using linear interpolation. This method was only applied to fill interior gaps and was not used for extrapolation.

3. GDP-weighted group average fill: All remaining missing values were imputed using a hierarchical GDP-weighted average based on the country's income group classification according to the World Bank. The general formula for the weighted share (*S'*) is:

   $$s_{c,t,j} = \frac{\sum_{c' \in G}\left(s_{c',t,j} \cdot GDP_{c',t}\right)}{\sum_{c' \in G} GDP_{c',t}},$$

   where *G* is a specific group of countries: low-income countries (LIC), lower-middle-income countries (LMIC), upper-middle-income countries (UMIC), and high-income countries (HIC). This calculation was applied using a three-tiered fallback system:

   - First, by using the weighted average of the country's income group for the specific missing year.
   - If data were insufficient, the weighted average of the income group across all available years was used.

- Finally, if still missing, the global GDP-weighted average across all countries and all years was used.

Once their shares in GDP have been estimated, the missing COFOG expenditures were computed using formula (1).

Fitted models

Two statistical models were used to explain the past progress in HDI and GHG emission reduction, respectively, by the levels of government expenditures across ten COFOG sectors. The models also include GDP and renewable energy consumption (for the GHG emissions equation only) as control variables reflecting the facts that economic growth is strongly linked to progress in human development and GHG emission growth, and that GHG emissions result from a balance between renewable and fossil energy sources. The models have the following mathematical formulations:

MODEL 2: $$\log HDI_t = a + \sum_{j=1}^{10} b_j \log pcGovExp_{t-1,j} + c \log pcGDP_t + \varepsilon_t$$

MODEL 3: $$\log pcEmissions_t = \alpha + \sum_{j=1}^{10} \beta_j \log pcGovExp_{t-1,j} + \gamma \log pcGDP_t + \delta \log Ren_t + \epsilon_t$$

Here HDI_t is the world's Human Development Index[5] in year *t; $pcGHG_t$* is the world's per capita GHG emissions[6] in year *t; $pcGovExp_{t,j}$* is the world's average per capita value of the governmental expenditures in COFOG[7] sector *j* in year *t* (estimated as an average over 178 countries available after imputation); $pcGDP_t$ is world's per capita Gross Domestic Product (GDP)[8] in year t; Ren_t is the global renewable energy consumption (as a percentage of total final energy consumption)[9] in year *t*; ε_t and ϵ_t are 'error' terms accounting for the deviations of data from the assumed model. Both explanatory ($pcGovExp_{t,j}$, *pcGDP_–t*, and Ren_t) and explained (HDI_t and $pcEmissions_t$) variables are log-transformed, which reflects the decreasing return to scale effects and enhances the quality of the model fit.

Models (2) and (3) were estimated using data spanning the period of 1995 to 2023 using the Ordinary Least Squares (OLS) method and estimates of coefficients *a*, b_j and *c* for model (2) and *α*, β_j, *γ*, and *δ* for model (3), were derived. Coefficients b_j and β_j are equal to the percentage change in HDI and per capita GHG emissions provided the per capita government expenditure in COFOG sector *j* increases by 1% and all other factors remain unchanged, respectively. Similarly, coefficients *c* and *γ* are equal to the percentage change in HDI and per capita GHG emissions provided GDP per capita increases by 1% and all other factors remain unchanged, respectively. Coefficient *δ* reflects a percentage change in the GHG emissions provided the renewable energy consumption increases by 1%. Lastly, coefficients *a* and *α* are free terms (intercepts) quantifying the levels of HDI and per capita GHG emissions level without the effects of government expenditures and the GDP. The results of models (2) and (3)'s estimation are presented in Table A1.

Table A1. Multivariate regression results for the Human Development Index (HDI) and per capita greenhouse gas (GHG) emissions. A positive (negative) value of a coefficient indicates that an increase in the corresponding explanatory variable is associated with an increase (decrease) in the explained variable, holding all other variables constant. Significance levels are indicated as follows: *** p ≤ 0.001; ** p ≤ 0.01; * p ≤ 0.05. Adjusted R^2 of model (1) and (2) are 0.996 and 0.973 respectively.

Model (1)	
Coefficient	Value
a	-2.702***
b_1	-0.028
b_2	-0.029
b_3	-0.063*
b_4	0.011
b_5	-0.006
b_6	-0.002
b_7	0.006
b_8	-0.007
b_9	0.044
b_{10}	0.044
c	0.216***

Model (2)	
Coefficient	Value
α	-1.033
β_1	0.097*
β_2	0.084
β_3	-0.177*
β_4	-0.017
β_5	0.0068
β_6	-0.018
β_7	-0.138*
β_8	-0.0067
β_9	-0.015
β_{10}	0.163
γ	0.475***
δ	-0.634***

Future scenarios

Scenario 1 Development action only is computed by solving the following optimization problem

$$\begin{cases} Minimize \sum_{j=1}^{10} pcGovExp_{t,j} \\ \log HDI_t^{\text{target}} \geq a + \sum_{j=1}^{10} b_j \log pcGovExp_{t-1,j} + c \log pcGDP_t^{\text{future projection}} \\ pcGovExp_{t,j} \geq s_{\text{world},2023,j} \cdot pcGDP_t^{\text{future projection}} \end{cases}$$

This problem identifies the lowest possible level of government expenditures that ensures meeting the HDI target in each year t from 2025 to 2030. The second inequality constraint requires that in the future, no COFOG category has lower expenditure than its level in the latest year with available data (2023), in relative terms to GDP. These shares were estimated as GDP-weighted means over the panel of 178 countries.

To solve this and other optimization problems discussed below, the per capita GDP projection until 2030 is estimated using the GDP projection by the IMF[10] ($GDP_t^{\text{future projection}}$) and the world population projection by the World Bank[11] ($Pop_t^{\text{future projection}}$) as follows:

$$pcGDP_t^{\text{future projection}} = \frac{GDP_t^{\text{future projection}}}{Pop_t^{\text{future projection}}}$$

Then the year-to-year growth trend is estimated. This growth trend is used to extrapolate the latest available value (2024) of GDP per capita for the world, retrieved from the World Bank.

Scenario 2 Climate action only is computed similarly, by solving the problem which, in each year *t* minimizes the total government expenditure that ensures that the GHG emission target is met while no COFOG expenditure is lower than its 2023 value.

$$\begin{cases} \mathit{Minimize} \sum_{j=1}^{10} pcGovExp_{t,j} \\ \log pcEmissions_t^{\text{target}} \leq \alpha + \sum_{j=1}^{10} \beta_j \log pcGovExp_{t-1,j} + \gamma \log pcGDP_t^{\text{future projection}} + \delta \log Ren_t^{\text{future projection}} \\ pcGovExp_{t,j} \geq s_{\text{world},2023,j} \cdot pcGDP_t^{\text{future projection}} \end{cases}$$

Here $Ren_t^{\text{future projection}}$ is the future projection of renewable energy consumption (as a percentage of total final energy consumption), estimated by extrapolating the observed trend in the data from 2011 to 2020.

Scenario 3 Climate and development synergies is computed by solving the problem with two targets:

$$\begin{cases} \mathit{Minimize} \sum_{j=1}^{10} pcGovExp_{t,j} \\ \log HDI_t^{\text{target}} \geq a + \sum_{j=1}^{10} b_j \log pcGovExp_{t-1,j} + c \log pcGDP_t^{\text{future projection}} \\ \log pcEmissions_t^{\text{target}} \leq \alpha + \sum_{j=1}^{10} \beta_j \log pcGovExp_{t-1,j} + \gamma \log pcGDP_t^{\text{future projection}} + \delta \log Ren_t^{\text{future projection}} \\ pcGovExp_{t,j} \geq s_{\text{world},2023,j} \cdot pcGDP_t^{\text{future projection}} \end{cases}$$

Synergies calculation

Intra-sectoral synergies under the non-fungibility assumption in a given year t are calculated as follows:

$$Synergy_t^{\text{non-fungibility}} = \sum_{j=1}^{10} \left(GovExp_{\text{world},t,j}^{\text{HDI only}} - GovExp_{\text{world},t,j}^{\text{baseline}} \right)$$
$$+ \sum_{j=1}^{10} \left(GovExp_{\text{world},t,j}^{\text{GHG emissions only}} - GovExp_{\text{world},t,j}^{\text{baseline}} \right)$$
$$- \sum_{j=1}^{10} \left(GovExp_{\text{world},t,j}^{\text{both targets}} - GovExp_{\text{world},t,j}^{\text{baseline}} \right).$$

Here $GovExp_{world,t,j}^{HDI\ only}$, $GovExp_{world,t,j}^{GHG\ emissions\ only}$, and $GovExp_{world,t,j}^{both\ targets}$ are the world's total government expenditures in scenarios 1, 2, and 3, respectively (computed using the per-capita values from the optimization problems multiplied by the future population projection from the World Bank). $GovExp_{world,t,j}^{baseline}$ are the baseline government expenditures. The assumption is that going forward, global government expenditures in each COFOG category will grow proportionally to the growing global GDP, as follows:

$$GovExp_{\text{world},j,t}^{\text{baseline}} = s_{world,j,t} \cdot GDP_{\text{world},t}^{\text{future projection}}$$

for each COFOG category *j* = 1,...,10, year *t* = 2025,...,2030.

Intra-sectoral synergies under the fungibility assumption are calculated as follows:

$$Synergy_t^{\text{fungibility}}$$
$$= \sum_{j=1}^{10} \left(\max\left(GovExp_{\text{world},t,j}^{\text{HDI only}}, GovExp_{\text{world},t,j}^{\text{GHG emissions only}} \right) \right.$$
$$\left. - GovExp_{\text{world},t,j}^{\text{baseline}} \right) - \sum_{j=1}^{10} \left(GovExp_{\text{world},t,j}^{\text{both targets}} - GovExp_{\text{world},t,j}^{\text{baseline}} \right)$$

Appendix 2. Excerpt from the Cities Quantification Table

Climate Action	SDGs	Physical Impacts	Monetary Impacts	Source
Thermal retrofits of residential buildings	1, 3, 7, 8, 9, 12, 13	10–35% increase in hours within thermal comfort zone 20–60% reduction in indoor $PM_{2.5}$ and NO_2	Up to $9,440/person/year in avoided health costs Up to 67,500 jobs created (depending on retrofit scale)	Ruiz-Valero, L., *et al.*, 2025
Urban Tree Canopy Expansion	1, 2, 3, 6, 8, 13, 14, 15	Air temperature (Tair) reduction: 0.5–2.0°C average, up to 9.4°C locally $PM_{2.5}$ removal: ~5.4 tonnes/year per 100,000 residents	In Phoenix, a 5% increase in urban vegetation saved $155 million/year in electricity cooling bills In Strasbourg, trees absorb 5 tons of $PM_{2.5}$ annually, avoiding ~$1.2 million/year in health-related externalities	Bai & Herath, 2024 Scholz *et al.*, 2018 Yang *et al.*, 2023 Pascal *et al.*, 2019
Low Emission Zones	1, 3, 10, 13, 15	10–44% reduction in roadside NO_2 across European LEZ cities 15–55% reduction in traffic-related $PM_{2.5}$ and black carbon emissions	Estimated health-related economic benefits: €120–475 million/year per city (based on pollution exposure modelling)	Schucht *et al.*, 2015 Sabel *et al.*, 2016
Cool Roofs	1, 3, 7, 8, 12, 13, 14	1.5–4°C surface temperature reduction 20–62% reduction in cooling energy demand Up to 70% reduction in future cooling energy needs when combined with ventilation and shading	Energy cost savings: 20–62% reduction in cooling-related electricity expenditure System-wide demand reduction: up to 70% when combined with ventilation/shading Net Present Value of cool roof retrofit programs: $4.4–$8.4 billion (major US cities)	Sharifi, 2021; Macintyre & Heaviside, 2019; Rosenfeld *et al.*, 1995

5 Endnotes

[1] https://sdgs.un.org/publications/synergy-solutions-climate-and-sdg-action-bridging-ambition-gap-future-we-want-56106
https://sdgs.un.org/synergy-solutions-world-crisis-tackling-climate-and-sdg-action-together

[2] A parsimonious statistical model is a simplified representation of a complex system that uses the fewest possible variables, parameters, and assumptions to explain the essential patterns or behaviours of interest. It strips away unnecessary complexity while retaining predictive or explanatory power.

[3] https://data.imf.org/Datasets/GFS_COFOG

[4] https://unctadstat.unctad.org/datacentre/dataviewer/US.GovExpenditures

[5] Data source: Human Development Report Office (HDRO), https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

[6] Data source: Emissions Database for Global Atmospheric Research (EDGAR), https://edgar.jrc.ec.europa.eu/report_2024?vis=ghgpop#emissions_table

[7] Data sources: International Monetary Fund (IMF), https://data.imf.org/Datasets/GFS_COFOG; United Nations Conference on Trade and Development (UNCTAD) Data Hub, https://unctadstat.unctad.org/datacentre/dataviewer/US.GovExpenditures

[8] Data source: World Bank World Development Indicators (WDI), https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD

[9] Data source: World Bank World Development Indicators (WDI), https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS

[10] Data source: IMF World Economic Outlook (WEO), https://www.imf.org/external/datamapper/datasets/WEO

[11] Data source: World Bank Population estimates and projections, https://databank.worldbank.org/source/population-estimates-and-projections

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